

AFOEHL REPORT 89-103EI0111JNA



AD-A215 757

**Measuring Day-Night Noise Levels (DNL)
Using The Metrosonics db-310 Sound
Level Analyzer (Dosimeter)**

ALI Y. ALI, 1Lt, USAF, BSC

SEPTEMBER 1989

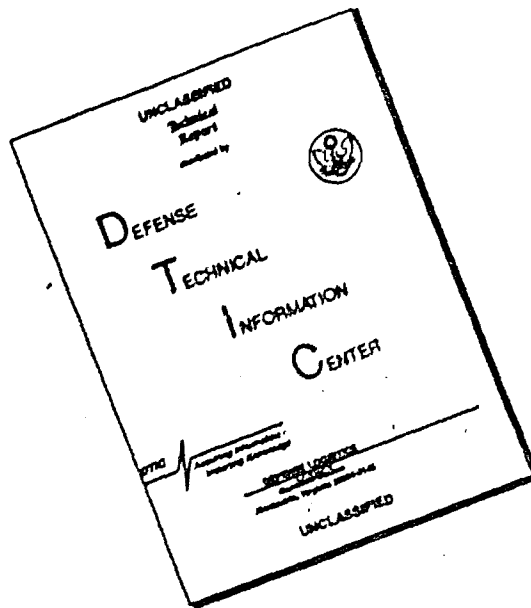
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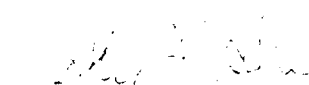
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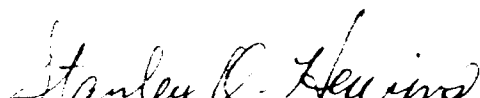
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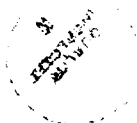

JAMES C. ROCK, Colonel, USAF, BSC
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REPORT DOCUMENTATION PAGE			FORM 100-101 DATE 10-1-84	
1. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		2. RESTRICTIVE MARKING NA		
3. SECURITY CLASSIFICATION AUTHORITY NA		4. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
5. CLASSIFICATION DOWN GRADING CODE NA		6. MONITORING ORGANIZATION REPORT NUMBER		
7. AUTHOR (Last, First, Middle Name) AFOEH/ Report 89-11111111		8. NAME OF PERFORMING ORGANIZATION USAF Occupational and Environmental Health Laboratory		
9. ADDRESS (City, State and ZIP Code) Brooks AFB TX 78235-5511		10. NAME OF MONITORING ORGANIZATION		
11. NAME OF FUNDING SPONSORING ORGANIZATION SAMHSA, DHEC		12. OFFICE SYMBOL (if applicable) PH		
13. ADDRESS (City, State and ZIP Code)		14. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
15. SOURCE OF FUNDING NUMBERS		16. PROGRAM ELEMENT NO		
17. PROJECT NO		18. TASK NO		
19. WORK UNIT ACCESS NO		20. TITLE (Include Security Classification) Measuring Day-Night Noise Levels (DNL) Using the Metrosonics db-310 Sound Level Analyzer (DOSIMETER)		
21. PERSONAL AUTHOR(S) 1Lt Ali Y. Ali				
22. TYPE OF REPORT Final		23. TIME COVERED FROM 1988-09-01 TO 1988-09-01		24. DATE OF REPORT (Year, Month, Day) September 1988
25. PAGE COUNT 36				
26. SUPPLEMENTARY NOTATION				
27. COSATI CODES		28. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP		
			Dosimeter Environmental Microcomputer	
			Noise Metrosonics db-310 Zenith Z-248	
			DNL Automation Zenith Z-184	
29. ABSTRACT (Continue on reverse if necessary and identify by block number)				
<p>Previous methods to acquire and monitor community noise levels at Air Force bases were time consuming. This report provides a method to use Metrosonics model db-310 Noise Dosimeters with Zenith Z-248 or Z-184 microcomputers to measure Day-Night Average Noise Levels (DNLs).</p>				
30. DISTRIBUTION/AVAILABILITY OF ABSTRACT		31. ABSTRACT SECURITY CLASSIFICATION		
<input checked="" type="checkbox"/> UNCLASSIFIED <input type="checkbox"/> CONFIDENTIAL <input type="checkbox"/> SECRET		Unclassified		
32. NAME OF RESPONDER TO REQUEST Ali Y. Ali, 1Lt, USAF, BSC		33. TELEPHONE (Include Area Code) (512) 536-3214		
		AFOEHL/EHI		

ACKNOWLEDGMENT

This report was made possible by the assistance of Maj John F. Seibert from AFDEHL/EMI who wrote the BASIC program to import data and calculate the DNI values and associated requirements.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	



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I. INTRODUCTION

A. Purpose: The primary purpose of this report is to document AFOEHL/EHI Noise Function procedures for down loading data from the Metrosonics db-310 noise dosimeter into ENABLE software and automatically calculate a day-night noise level (DNL). The secondary purpose is to make this report available to base level bioenvironmental engineers so they can perform DNL monitoring.

B. Problem: The Metrosonics db-310 Dosimeter does not provide automatic calculation of DNLs for environmental noise surveys. Previous environmental noise surveys using the db-310 Dosimeter required DNL values to be calculated manually from the paper printout of sound levels. Manual calculations proved to be both laborious and monotonous; worse, one missed key stroke would require a restart of this whole calculation. In addition, the quality of the printouts are very poor if reproduction is required. The manual method of DNL calculating made long term environmental noise monitoring tedious and labor intensive with many opportunities for error.

C. Scope: This report presents a program listing, setup requirements, procedures and operating instructions for DNL calculations using the Metrosonics db-310 Noise Dosimeter, a Z-248 or Z-184 Microcomputer, ENABLE software, and a BASIC program. Procedures and operating instructions describe (1) programming the Metrosonics db-310 Dosimeter parameters for environmental noise measurements, (2) down loading its data to a Zenith Z-248 or Z-184 Computer using ENABLE, and (3) running a BASIC program which calculates the DNL and provides a hard copy of the results.

D. Flexibility and Limitation: The BASIC program can be modified to generate different printout formats. ENABLE communication Macros can be created to accelerate the down loading of dosimeter data. The program will not print out the AF Form 2756A, Noise Dosimeter Survey.

II. GENERAL DISCUSSION

A. DNL Criteria Overview: In addition to the normal db-310 use for occupational noise exposure measurements, the db-310 can be used to measure the average day-night sound level (DNL) for community noise criteria and compliance. However, community environmental noise ordinances could vary within the same area due to the type of zoning and the type of criteria adopted by the surrounding community. For example, one township specified maximum sound pressure level for each octave band that could not be exceeded at any time. The Department of Housing and Urban Development (HUD) uses a criterion of 65 dB or less for DNL criterion before approving funds for housing projects. The EPA DNL goal is 55 dB. As a result, the surrounding community dictates the type of criteria for environmental noise. Therefore, the applicable criteria for the site(s) of interest should be defined before conducting an environmental noise survey due to the wide range of zoning variations. The local community planning authority would be the source of information for the applicable ordinances that have to be met. Additional information can be found in 24 CFR, Subtitle A, Part 51, Environmental Criteria and Standards, and AFM 19-10, Planning in the Noise Environment. The DNL convention is used to measure the 24 hour community environmental noise.

DNL is a 24 hour A-weighted equivalent sound level, with a 10 dB penalty applied to the nighttime sound levels occurring between the hours of 2200 and 0700. The abbreviations Ldn and DNL are used by various authors for DNL. DNLs are calculated by the equation:

$$Ldn = 10 \log 1/24 [15 \times 10^{(Ld/10)} + 9 \times 10^{(Ln+10/10)}]$$

Ld = Daytime equivalent A-weighted sound level between the hours of 0700 and 2200.

Ln = Nighttime equivalent A-weighted sound level between the hours of 2200 and 0700.

B. DNL General Requirements Overview:

1. Metrosonics db-310 Parameters for DNL Measurements:

The requirements in setting up the Metrosonics db-310 parameters for DNL measurements are:

- a. The doubling rate is 3 dB instead of 4 dB.
- b. The test length is 24 hours instead of 8 hours.
- c. The time interval is one hour instead of one minute.
- d. Ln(1), Ln(10), Ln(50), Ln(90) exceedance levels should be used.

NOTE: Ln(x.x%): Exceedance Levels - The noise levels exceeded x.x% percent of the time.

Ln(1.0%): Peak noise level - Noise level exceeded 1% of the time.

Ln(10.0%): Intrusive noise level - Noise level exceeded 10% of the time.

Ln(50.0%): Median noise level - Noise level exceeded 50% of the time.

Ln(90.0%): Background ambient noise level - Noise level exceeded 90% of the time (i.e., only 10% of the time noise levels were below this level).

2. General Data Transfer Overview:

The db-310 Dosimeter can output information in response to a remote request in ASCII format to a microcomputer. It cannot be programmed from a computer (see the db-310 Manual, Page 2-35). The computer can communicate with the Metrosonics db-310 using ENABLE communication software to capture and save data as text or ASCII format. The general process for downloading the db-310 noise data requires (a) establishing the connection

between the computer and the db-310, (b) transmitting commands and receiving data from the db-310 to the computer using a compatible communication protocol setup, (c) capturing received data and saving it, and (d) disconnecting when transmitting, receiving, capturing, and saving data are complete.

3. Calculating DNL from saved data using a computer program:

Calculating DNL from saved data can be accomplished with a BASIC computer program. It can be written to retrieve stored data, calculate the DNL and save results on a disk. This program is listed in Appendix C. The DNL BASIC program listed in Appendix C requires execution from the C drive.

III. PROCEDURES

A. ENABLE communication setup:

See Appendix A on how to establish and save the communication protocol file.

B. db-310 Dosimeter Setup and Measurements:

1. Decide how many sites need to have DNL measurements, and how much data needs to be recorded.

2. Program the Metrosonics db-310 Dosimeter as follows:

a. SNO LEV key

- (1) Calibrate Metrosonics db-310
- (2) Change doubling rate to 3 dB

b. TIME key

- (1) Input current date and time
- (2) Input start date and time
- (3) Input test run for 24 hours
- (4) Select SCHED RUN: ON

c. DATA key

- (1) TIME HIST
 - (a) Select INT MODE: CONT
 - (b) Input a length of one hour
 - (c) Select CATCH-1: NO
 - (d) Select STAT: Av Mx PK

(2) AMP DIST

- (a) Input DST Ln(1): 1.0°
- (b) Input DST Ln(2): 10.0%
- (c) Input DST Ln(3): 50.0%
- (d) Input DST Ln(4): 90.0%

d. OTHER PARAMETERS: Leave at default values.

3. We recommend placing the db-310 dosimeters in zip-lock plastic bags and securing them at the site with the microphone cable running out the bottom of the bag (i.e., secure the dosimeter upside down). This will prevent moisture accumulation in the bag and will protect the dosimeter data from being lost if it should rain during the survey. Of course any other weatherproof method of securing the dosimeters in the field is acceptable. Place and secure the db-310 dosimeter at the site of interest. Cover the microphone with the windscreen, then place and secure it approximately 1.5 to 1.75 meters above the ground. To prevent moisture damage to the microphone due to moisture condensation or rain, it should be pointed toward the noise source and secured upside down.

4. When data collection is complete, post calibrate the db-310 dosimeter.

5. Down Loading Data Into ENABLE:

Down load data from the db-310 dosimeter to the microcomputer and save it to disk as an ASCII file using the communication portion of ENABLE software according to the following procedures:

1. Connect the output on the bottom of the db-310 dosimeter to the RS-232 serial port on the back of the Z-184 or to COM1 of the Z-248 by using in series: the Metrosonics dosimeter printer cable, a 25-pin female-female gender changer (or adapter cable), and a 25-pin to 9-pin adapter plug or cable.

2. Turn the dosimeter on. Press [PROG] and [DATA]; select [OUTPUT] and press [ENTER]. Select [9600] baud rate, [TABLE], [TITLE FORM:NO]. The dosimeter is configured to the proper communication parameters for the ENABLE telecommunication file "DB310" created in Appendix A.

3. Turn on the computer without a floppy disk in the 'A' drive. Allow the computer to boot from the hard disk. Enter the date and time, then Run ENABLE.

4. Establish the connection to the dosimeter. Enter the date and time on the initial screen or press [END]. Select [USE SYSTEM], [TELECOM], [COMMUNICATE], [USE SETUP]. The system is now in the communication portion of ENABLE.

FILE(ON/OFF), 1 = ON, 0 = OFF. The flag indicates file to be ready for capturing data. When it is ready to receive data, the flag must be set and the data will be automatically captured.

Now press ENTER on the keyboard followed by ENTER on the terminal. This will tell the computer to receive and capture incoming information from the computer's keyboard.

(5) When down loading is complete, close the captured file by pressing [F10]. Select [Capture] then [Close].

7. To end the telecommunication session, press [F10]. Select [DISCONNECT], (are you sure?) [YES], (save captured data?) [YES], [CHANGE], [ASCII], [ENTIRE FILE], [SAME].

4. Press [F10] then exit to DOS.

5. If a hard copy of the saved data file is required, then at the CP prompt type [TYPE\ENABLE\FILENAME.TPF >LPT1] then press [ENTER] and the printer will start printing the original Metrosonics specified data file. FILENAME is the name of the saved file selected to be printed.

3. Running DNL BASIC Program:

Run the DNL BASIC program (Appendix C, which should have already been saved on drive C) to calculate the DNLs from the saved captured data using the following procedures:

1. Enter the directory of BASIC: While at the DOS prompt (C:), turn the printer on, then go to BASIC by typing [CD\BASIC] then [BASICA].

2. After the [OK] prompt appears, enter [LOAD"DNL"]. The [OK] prompt will appear again.

3. Run the DNL program by entering [RUN] or pressing [F2].

4. The BASIC program will explain its purpose and will check you to see if the printer is connected and ready before proceeding. It will also ask you for the file name you want to process. Type the full path to the file as instructed by the program then press [ENTER]. The program will start the calculations and print a hard copy of the calculated DNL. See Appendix B for an example of the DNL program output.

IV. SUMMARY

The steps to download Metrosonics dB-113 data and calculate DNL measurements have been summarized as follows: (1) create and save the captured data file setup, (2) type and save the listed DNL BASIC program on drive C, (3) download and save data, and (4) run the DNL BASIC program to calculate and print a hard copy of DNL noise levels.

V. CONCLUSIONS

The program for Metrosonics dB-113 Noise Dosimeter data and calculating DNLs has been shown with the time required to calculate DNLs, and the computer requirements needed. It also provides a method for automation of the calculations and noise level. Finally, by using these calculations, Metrosonics dB-113 Noise Dosimeter and a Zenith Micro computer, the noise level can be calculated for measuring community noise levels.

VI. RECOMMENDATIONS

For future work on environmental noise survey, review applicable regulations and regulations for noise levels according to the community noise.

2. Because community noise compliance measurements require long term data acquisition and analyses, recommend all base bioenvironmental engineers use the method described in this report for DNL community noise measurements.

3. The method provided can be accelerated and modified by running ENABLE under macros. Recommend expert users of ENABLE develop their own macros to run ENABLE setups.

REFERENCES

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2. AFR 161-35, Hazardous Noise Exposure (9 Apr 82)
3. Carrol, Michael M. "Introduction to Noise and Acoustic Terminology" Community Noise Control: Prediction, Measurement, and Regulation, A two day conference/Dec 2-3, 1976, San Francisco CA, Continuing Education in Engineering, University Extension, and The College of Engineering, University of California, Berkeley (Dec 1976)
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6. Operation/Maintenance Manual, db-310 Sound Level Analyzer, cl-303 Acoustical Calibrator; Metrosonics Inc.
7. U.S. Department of Housing and Urban Development, Washington D.C. Office of Policy Development and Research, "Technical Background for Noise Assessment Guidelines", pp. III-48-55, HUD0002272 (Jan 1980)
8. U.S. Environmental Protection Agency. "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." EPA Report No. 550/9-74-004, (Mar 1974)
9. 24 CFR, Subtitle A, Part 51, "Environmental Criteria and Standards"

APPENDIX A

ENABLE COMMUNICATION SETUP PROTOCOL FOR THE
METROSONICS MODEL db-310 NOISE DOSIMETER

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ENABLE/db-310 COMMUNICATION FILE SETUP

1. When at the main menu, select **[USE SYSTEM]**, **[TELECOM]**, **[SETUP]**, **[ENTER]**. The screen will show the telecommunication setup form definition. Read the screen then press any key to continue.
2. You will be prompted to enter the name of the setup you wish to create or revise. Type DB310 then press **[ENTER]**. The screen will ask you to select setup parameters. Follow the following setup:
 - a. Special digits for outside line? Select **[NO]**
 - b. Alternative telephone system? Select **[NO]**
 - c. Telecommunication network? Select **[NO]**
 - d. Enter telephone number: **[leave blank by pressing DOWN ARROW]**
 - e. Autodial Modem? Select **[NO]**
 - f. Baud rate: Select **[7=9600]**
 - g. Parity option: Select # **[3]**
 - h. Type of duplex: Select **[HALF]**
 - i. Inter-character transmission delay: Select **[0]**
 - j. Other system supports Xon/Xoff? Select **[Y]**
 - k. Password or first response: **[Leave blank by pressing DOWN ARROW]**
 - l. Second Response: **[Leave blank by pressing DOWN ARROW]**
 - m. For the remaining options use default setup by pressing **[F10]**, then selecting **[SAVE]**. The screen will show that the setup file has been created and saved under "Setup Name" as "DB310", "Auto Dial" as "N", "Baud Rate" as "9600", and "Code" as "3H". Press **[F10]** to exit the setup portion and go to the main menu.

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APPENDIX B

DNL (BASIC) PROGRAM INPUT/OUTPUT EXAMPLES

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Example of the original Metrosonics db-310 Noise Dosimeter data file which is down loaded through the telecommunications portion of ENABLE and then saved as an ASCII file for use as input to the DNL BASIC program to produce the DNL report.

METROSONICS db-310 SN 501 V1.3 3/87
REPORT PRINTED 7/05/89 @ 10:29:29

DOUBLING RATE: 3dB FILTER: A WGH
DOSE CRITERION: 84dB RESPONSE: SLOW (G/SEC)
PRE-CALIBRATION TIME: 6/14/89 @ 20:37:12
PRE-CALIBRATION RANGE: 69.0dB TO 169.0dB
POST-CALIBRATION TIME: 6/21/89 @ 14:42:11
POST-CALIBRATION RANGE: 43.7dB TO 143.7dB

CALIBRATOR TYPE & SERIAL # : _____

CALIBRATOR CALIBRATION DATE: _____

TEST BEGAN 6/19/89 @ 16:00:00
TEST ENDED 6/20/89 @ 16:00:00
TEST LENGTH: 1DAYS 0:00:00
STANDBY TIME: 1 INTERRUPTION

Lav = 80.4dB Lav (80)= 80.0dB
SEL =129.6dB Lav (90)= 79.8dB
Lmax =126.0dB ON 6/20/89 @ 11:04:40
Lpk = 168dB ON 6/20/89 @ 11:04:40
TIME OVER 115dB 0D 0:00:04.62

8 HR DOSE (80dB CUTOFF)=119.18%
8 HR DOSE (90dB CUTOFF)=114.05%

TIME HISTORY REPORT

OF PERIODS: 24 MODE: CONTINUOUS

PERIOD LENGTH: 1:00:00

TIME HISTORY CUTOFF: NONE

"Ln(1): 10.0" "Ln(2): 50.0"

DATE: 6/19/89 TAG #: 1

INT	TIME	"Lav"	"Lmx"	"Lpk"	"L1"	"L2"
1	"16:00:00"	71.5	91.3	<126	72	69
2	"17:00:00"	69.4	83.8	<126	69	69
3	"18:00:00"	69.0	69.0	<126	69	69
4	"19:00:00"	69.3	82.8	<126	69	69
5	"20:00:00"	69.0	70.6	<126	69	69
6	"21:00:00"	69.0	69.0	<126	69	69
7	"22:00:00"	69.0	69.0	<126	69	69
8	"23:00:00"	69.0	69.0	<126	69	69
9	"0:00:00"	69.0	69.0	<126	69	69
10	"1:00:00"	69.0	69.0	<126	69	69
11	"2:00:00"	69.0	69.0	<126	69	69
12	"3:00:00"	69.0	69.0	<126	69	69
13	"4:00:00"	69.0	69.0	<126	69	69
14	"5:00:00"	69.1	84.3	<126	69	69
15	"6:00:00"	71.9	100.1	131	69	69
16	"7:00:00"	76.4	100.3	132	75	69
17	"8:00:00"	79.6	111.1	141	76	69
18	"9:00:00"	90.5	119.7	149	81	71
19	"10:00:00"	71.9	89.1	<126	73	70
20	"11:00:00"	90.5	126.0	168	76	70
21	"12:00:00"	74.6	102.8	133	75	69
22	"13:00:00"	74.7	95.3	<126	77	70
23	"14:00:00"	74.4	101.4	131	74	69
24	"15:00:00"	73.9	94.4	<126	76	70

** AMPLITUDE DISTRIBUTION REPORT **

TOTAL SAMPLES = 691200

dB	SAMPLES	% OF TOTAL
69	543561 *****	78.64
70	43582 *****	6.30
71	28447 *****	4.11
72	18071 ***	2.61
73	12487 **	1.80
74	9013 *	1.30
75	6632 *	.95
76	4953 *	.71
77	4247 *	.61
78	3498 *	.50
79	3090 +	.44
80	2552 +	.36
81	2065 +	.29
82	1585 +	.22
83	1379 +	.19
84	1030 +	.14
85	817 +	.11
86	702 +	.10
87	586 .	.08
88	406 .	.05
89	360 .	.05
90	310 .	.04
91	260 .	.03
92	227 .	.03
93	201 .	.02
94	172 .	.02
95	124 .	.01
96	109 .	.01
97	101 .	.01
98	81 .	.01
99	61	.00
100	59	.00
101	43	.00
102	49	.00
103	53	.00
104	42	.00
105	34	.00
106	44	.00
107	31	.00
108	28	.00
109	18	.00
110	14	.00
111	16	.00
112	9	.00
113	8	.00
114	6	.00

13	14	OF TOTAL
111	1	.00
112	1	.00
113	1	.00
114	1	.00
115	1	.00
116	1	.00
117	1	.00
118	1	.00
119	1	.00
120	1	.00
121	1	.00
122	1	.00
123	1	.00
124	1	.00
125	1	.00
126	1	.00

127 11.00 = 83dB
 128 10.00 = 72dB
 129 50.00 = 69dB
 130 90.00 = 69dB

	70	80.9dB	90.0dB
	CUTOFF	CUTOFF	CUTOFF
L10d	73.7dB	69.6dB	72.7dB
L10sha	71.7dB	71.2dB	70.5dB
L1eq(6)	71.0dB	70.5dB	69.8dB

Output example (DNL Report) of the DNL BASIC program generated from the input file (down loaded Metrosonics db-310 Noise Dosimeter data file).

METROSONICS db-310 SN 501 V1.3 3/87
 REPORT PRINTED 7/05/89 @ 10:29:29
 DOUBLING RATE: 3dB FILTER: A WGT
 DOSE CRITERION: 84dB RESPONSE: SLOW (8/SEC)
 PRE-CALIBRATION TIME: 6/14/89 @ 20:37:12
 PRE-CALIBRATION RANGE: 69.0dB TO 169.0dB
 POST-CALIBRATION TIME: 6/21/89 @ 14:42:11
 POST-CALIBRATION RANGE: 43.7dB TO 143.7dB
 CALIBRATOR TYPE & SERIAL # : _____
 CALIBRATOR CALIBRATION DATE: _____
 TEST BEGAN 6/19/89 @ 16:00:00
 TEST ENDED 6/20/89 @ 16:00:00
 TEST LENGTH: 1DAYS 0:00:00
 STANDBY TIME: 1 INTERRUPTION
 Lav = 80.4dB Lav (80)= 80.0dB
 SEL =129.6dB Lav (90)= 79.8dB
 Lmax =126.0dB ON 6/20/89 @ 11:04:40
 Lpk = 168dB ON 6/20/89 @ 11:04:40
 TIME OVER 115dB 00 0:00:04.62
 8 HR DOSE (80dB CUTOFF)=119.18%
 8 HR DOSE (90dB CUTOFF)=114.05%

Lavg values for each hourly interval for the dosimetry

Hour of Day	Lavg (db)	# intervals used for each hourly Lavg
1 :00	69	1
2 :00	69	1
3 :00	69	1
4 :00	69	1
5 :00	69.1	1
6 :00	71.90001	1
7 :00	76.4	1
8 :00	79.6	1
9 :00	90.5	1
10 :00	71.90001	1
11 :00	90.5	1
12 :00	74.6	1
13 :00	74.7	1
14 :00	74.4	1
15 :00	73.90001	1
16 :00	71.5	1
17 :00	69.4	1
18 :00	69	1
19 :00	69.3	1
20 :00	69	1
21 :00	69	1
22 :00	69	1
23 :00	69	1
24 :00	69	1
DNL (Ldn) = 81.45118 dB		

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APPENDIX C
DNL (BASIC) PROGRAM LISTING

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THE BASIC PROGRAM LISTING

```

1000
1010 PRINT "DNL Program to convert Metrosonics db 310 text file downloaded by"
1020 PRINT "ENABLE or PROCOM communications programs into a single DNL (Ldn)"
1030 PRINT "value."
1040 PRINT
1050 PRINT "Be sure printer is connected and ready before proceeding."
1060 PRINT
1070 ' Program written by AF0EHL/EHL, Noise Hazards Function
1080 ' Maj John Seibert
1090 ' Last revised 7 Nov 89 by Maj Terry Fairman and 1Lt Ali Ali
1100 '
1110 DIM CALC(24),LAVG(24),COUNT(24) 'Arrays to hold the intermediate
1120 ' calculation values, Lavg and number
1130 ' of total time periods for each of the
1140 ' 1-hr intervals in a 24 hr period
1150 DEF ENRD(R)=INT(R*10+.5)/10 'Round numbers to the nearest 0.1
1160 'Zero out each of the arrays
1170 FOR I=0 TO 23
1180 CALC(I)=0:LAVG(I)=0:COUNT(I)=0
1190 NEXT I
1200 '
1210 'Open the Metrosonics text file for reading
1220 '
1230 PRINT : PRINT "Enter the name of the Metrosonics db 310 text file"
1240 PRINT "that you want the DNL (Ldn) calculated from"
1250 PRINT
1260 PRINT "(i.e. 'A:\AOX920.TXT' for file 'AOX920.TXT' on the A drive) "
1270 PRINT "(For files created from ENABLE, enter \ENABLE\filename.IPF)"
1280 INPUT FILENAMES
1290 PRINT
1300 PRINT "DNL (Ldn) Calculations for File: ";FILENAMES
1310 PRINT
1320 OPEN FILENAMES FOR INPUT AS #1
1330 PRINT
1340 PRINT "Enter the name of the output file to save the DNL printout into"
1350 PRINT "or REOPEN without a name if you do not want to save as a file)"
1360 PRINT
1370 INPUT OUTNAMES
1380 IF LEN(OUTNAMES)>0 THEN OPEN OUTNAMES FOR OUTPUT AS #2
1390 IF LEN(OUTNAMES)>0 THEN LPRINT "Calculations also saved in File:"
1400 IF LEN(OUTNAMES)>0 THEN PRINT #2,"DNL Calculations for File: ";FILENAMES
1410 '
1420 'Print out first 21 lines of header data and print out as is
1430 '
1440 FOR I=1 TO 21
1450 LINE INPUT#1,INTERV$
1460 IF LEN(INTERV$)=0 THEN GOTO 460 'Throw out blank line
1470 'Throw out Formfeed
1480 IF LEFT$(INTERV$,1) CHR$(12) THEN INTERV$=MID$(INTERV$,2)
1490 IF MID$(INTERV$,2,2) "DA" THEN 570
1500 PRINT INTERV$

```



```

1060 'Calculating Day-time values
1070 DNLALC=DNLALC+(1*((LAVG(I)/10))
1080 GOTO 1090
1070 'Calculating Night-time values with 10 dB penalty
1080 DNLALC=DNLALC+10*((LAVG(I)+10)/10)
1090 NEXT I
1100 PRINT:PRINT "Calculating the final DNL value."
1110 'Calculating DNL
1120 '
1130 IF DNLALC=0 THEN GOTO 1160
1140 DNL=10*((LOG(DNLALC)-LOG(10))-(LOG(LAVGCNT)/LOG(10)))
1150 '
1160 ' Printing out results
1170 PRINT:PRINT "Printing out results."
1180 LPRINT
1190 LPRINT "Lavg values for each hourly interval for the dosimetry"
1200 LPRINT
1210 LPRINT " Hour Lavg Interval"
1220 LPRINT "of Day (db) Number"
1230 LPRINT "-----"
1240 FOR I=0 TO 23
1250 IF I>9 THEN TS=MIDS(STR$(I),2,2)+"00":GOTO 1270
1260 TS="0"+MIDS(STR$(I),2,2)+"00"
1270 LPRINT " ";:LPRINT USING "\ ";TS;:LPRINT USING
"###.##";LAVG(I);:LPRINT " ";:LPRINT USING "##";COUNT(I)
1280 NEXT I
1290 LPRINT
1300 LPRINT "DNL (Ldn) = ";FNRD(DNL);" dB"
1310 LPRINT CHR$(12) 'FormFeed at end of printing
1320 '
1330 IF IF$(OUTNAMES)=0 GOTO 1490
1340 PRINT #2," "
1350 PRINT #2,"Lavg values for each hourly interval for the dosimetry"
1360 PRINT #2," "
1370 PRINT #2," Hour Lavg # intervals used"
1380 PRINT #2,"of Day (db) for each hourly Lavg"
1390 FOR I=0 TO 23
1400 IF I>9 THEN TS=MIDS(STR$(I),2,2)+"00":GOTO 1420
1410 TS="0"+MIDS(STR$(I),2,2)+"00"
1420 PRINT #2," ";TS;" ";:PRINT #2,USING "###.##";LAVG(I);:PRINT #2,
" ";:COUNT(I)
1430 NEXT I
1440 PRINT #2," "
1450 PRINT #2,"DNL (Ldn) ";FNRD(DNL);" dB"
1460 PRINT #2,CHR$(12) 'Print a Form Feed character at end
1470 CLOSE #2
1480 '
1490 CLOSE #1
1500 CLS
1510 PRINT
1520 LOCATE 13,27:PRINT "DNL calculations completed":BEEP:BFEP:BEEP:PRINT
1530 INPUT "Do another DNL calculation?",ANSS
1540 IF ANSS="Y" OR ANSS="y" THEN CLS:GOTO 170
1550 CLS:LOCATE 12,32:PRINT "***FINISHED!***"
1560 STOP

```

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APPENDIX D
HARDWARE AND SOFTWARE REQUIREMENT LIST

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HARDWARE AND SOFTWARE REQUIREMENTS LIST

HARDWARE

1. MICROCOMPUTERS: Either Z-248, Z-184, or a PC compatible
2. CABLES AND CONNECTORS:
 - Metrosonics db-310 Dosimeter Printer Cable
 - 25-pin Female-Female Gender Changer (or Adapter Cable)
 - 25-pin to 9-pin Adapter Plug or Cable

SOFTWARE

1. ENABLE V.2.15 or 0A
2. GW BASIC
3. DNL BASIC PROGRAM

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